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NOTES ON THE BIOLOGY AND CONTROL OF ARCHIPS RETINIANA
(Wlsm.) AND AN UNIDENTIFIED SPECIES OF NEODIPRION

by

W. J. Buckhorn

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~~The Results of DDT Spray Tests on~~ Archips retiniana (Wlsm.) and an
Unidentified Species of Neodiprion.

by
W. J. Duckhorn

During the course of a hazard survey on the Snow Mountain District of the Ochoco National Forest in late July and early August 1945, it was soon discovered that ponderosa pine reproduction and poles on the west half of the area, embracing some 96,000 acres, had suffered varying degrees of defoliation and that the terminals of many leaders and twigs were turning yellow. In many cases both ^{insects} were in evidence on the same trees. The insect attacking the terminals was identified ^{by Mr. Carl Heinrich} as Archips retiniana (Wlsm.), a race of the spruce budworm. The defoliation was caused by a sawfly, an unidentified species of Neodiprion.

Neodiprion sp. Hopk. U.S. No 31,645a

This insect feeds upon the foliage of ponderosa pine reproduction, poles and, in some instances, lower branches of mature trees. When the infestation is heavy, complete defoliation may result. However, this does not seem serious as trees completely denuded in 1945 put forth new foliage in 1946, and except for a general weakening effect, little harm seemed to result.

It is very unlikely that complete defoliation would occur for two successive seasons in the same area, due to the fact that the female requires foliage in which to deposit her eggs. Just when oviposition occurs is not known. Up to 20 or more eggs are deposited singly within slits cut along the edge of the needle. The eggs apparently hatch in late May or early June, as on June 12, 1946 a

few eggs, many first instar and a few second instar larvae, were found.

Larvae feed gregariously. While small, up to 20 or more congregate on a single needle. They usually consume the needles down to the sheath leaving only a stub. The larvae seem to prefer the older needles and do not generally attack the current season's growth unless defoliation is severe. Towards the end of July the larvae become full grown and migrate from the tree to pupate between the duff and mineral soil. Emergence occurs during late August and early September.

Archips retiniana (Wlsm.) Hopk. U.S. No. 31,644 a

The insect attacks the terminals of leaders and twigs on ponderosa pine reproduction and poles, usually confining its activities to the upper portion of the crown. It shows a preference for the dominant or open-grown trees.

The majority of the terminals attacked cease to grow and many die back to the growth of the preceding year. When infestation is light the terminal of the leader is usually attacked and may result in a forked tree. Heavy or repeated attacks cause the trees to become severely deformed and stunted. ~~Some may never recover.~~

It is not known when or where the eggs are deposited but in 1946 about 1/4-grown larvae were present on June 12. The larvae spin a protective webbing among the immature needles, usually close to the stem or between two adjacent terminals. They remain under the web during the day. Towards dusk they begin emerging to feed. Feeding is accomplished by boring a small hole through the side of the needle sheath and consuming that portion of the needle bundle

within the sheath. The severed needles soon turn yellow, then red. Those not bound by the webbing break over and soon drop off. Toward the end of July pupation takes place among the dead needles. The pupae may be partially concealed by the protective webbing. Emergence occurs in about a week or so. The adults are also nocturnal in habits. Little mortality occurs when these species attack individually. However, it is common for both insects to attack the same trees which results in loss of foliage and injury to the terminals. As a result the tree has little chance of survival, especially when attacks are heavy.

The serious threat presented by this widespread infestation made it advisable to test the effectiveness of DDT against these insects under field conditions as a basis for artificial control should such measures become necessary. The area selected for the test lay at approximately 6000 feet elevation; topography level with a western exposure; site quality 4+; ponderosa pine type. The mature stand was open with a good stand of reproduction, somewhat grouped but no dense clumps, ranging up to 18 feet in height with an average of about 9 feet. Reproduction was lightly defoliated in 1945. Heavy broods of both insect species were present early in 1946.

Due to the great distances involved in transporting materials to this remote area it was decided to test the DDT in the form of a water emulsion spray. A stock solution containing 20% DDT was made up at the laboratory. This consisted of 1 lb. DDT, 3 lbs. 10 oz. xylene solvent, and 6 Oz. Triton x 100 emulsifier. In the field the required amounts of this solution were added to three gallons of water to make a spray containing the desired percentages of DDT. The spray was applied with a three gallon hand compression sprayer using a bordeaux nozzle. Trees were sprayed until runoff was imminent.

On June 27 four plots were sprayed with the following percentages of DDT:

1.0%	applied	to	209	trees	ranging	from	4	to	8	feet	in	height
0.50%	"	"	114	"	"	"	6	to	8	"	"	"
0.25%	"	"	119	"	"	"	6	to	8	"	"	"
0.125%	"	"	52	"	"	"	8	to	16	"	"	"

The sawfly larvae which were about 1/4 grown began showing signs of distress soon after being sprayed, but nearly an hour elapsed before mortality began occurring. The next morning some 16 hours after the last plot was sprayed no live sawfly larvae could be found except on one limb which apparently had been missed on the 1.0% plot.

The larvae of Archips which also were about 1/4 grown remained under cover of the webbing they spin between the needles and were protected from the spray. Not until they emerged for feeding purposes did they come in contact with the DDT. The next morning, some 16 hours after the last plot was sprayed, numerous dead Archips larvae were observed suspended by silken threads; others had fallen from the terminals and were lodged on the lower branches and needles. A few live larvae which apparently did not come in contact with the DDT were found.

Rain appeared imminent when the spraying was begun at 10:30 a.m. but held off until 5 p.m., an hour after the last plot had been completed. It continued to rain throughout the night, abated for a while early next morning, June 28, then continued to rain for the next three days, making it impossible to complete the tests at this time.

The tests were resumed on July 10 under a clear sky and bright sun. The larvae of both insect species appeared to be about half grown.

Four additional plots were sprayed using the following percentages of DDT:

.06% applied to 93 trees up to 12 feet in height.

.03% " " 45 " " " 16 " " "

.015% " " 61 " " " 18 " " "

.007% " " 70 " " " 10 " " "

Spraying was completed at 5:50 p.m. The plots were examined about 8 a.m. the following morning. No live sawfly larvae were found on the plots treated with .06% and .03% spray. A few live larvae, though apparently affected by DDT, were found wandering about on the plots treated with .015% and .007% DDT. No live Archips retiniana were found, although many dead ones were observed suspended by a web or lodged on the needles or twigs.

Plots which were sprayed on June 28, 1946 were also examined. No live larvae of either species could be found.

All plots were again examined on July 24, 1946. No live larvae of either insect could be found. No further defoliation had occurred, although reproduction adjacent to the plots had been heavily defoliated. Terminals on which the Archips larvae had been killed by DDT continued to grow and the uninjured needles reached full length, while outside of the plots attacked terminals ceased to grow and were turning yellow.

All percentages of DDT tested gave 100% control of both the sawfly and Archips retiniana. It is possible that even lower concentrations of DDT may have been effective.

When the plots were examined on July 24, 1946 it was found that sometime after the last spraying the sawfly population had contracted a deadly wilt disease. The mummified remains of half to nearly full grown larvae were hanging from needles and twigs

everywhere. Apparently 85 to 90% of the brood succumbed. This natural control factor saved large areas of ponderosa pine reproduction from being completely stripped. The Archips apparently were unaffected by the disease as no dead larvae could be found.

Summary

Late in July 1945 two insects, one a moth, Archips retiniana (Wlsm.), the other a sawfly, an unidentified species of Neodiprion, were discovered to be defoliating ponderosa pine reproduction on ^{some 96,000 acres on} the west half of the Snow Mountain District, Ochooco National Forest. The moth attacks the current season's growth and the sawfly prefers the older foliage. Attacks by either species cause but little mortality. However, both insects frequently attack the same trees causing considerable mortality especially under epidemic conditions.

The seriousness of the situation made it advisable to test the effectiveness of DDT against these insects under field conditions as a basis for artificial control should such measures become necessary.

Due to the long distance involved in transporting materials a water emulsion spray was decided upon. A stock solution containing 20% DDT was prepared at the laboratory. In the field quantities of this solution were diluted with water to make a spray having the desired DDT content. The spray was applied with a hand compression sprayer with a bordeaux nozzle.

1946

The larvae of both species were about 1/4 grown on June 23¹⁹⁴⁶ when spray was applied to four plots in the following concentration: 1.0% applied to 209 trees, 0.50% to 114 trees; 0.25% to 119 trees, and 0.125% to 52 trees. Mortality began occurring among the sawfly larvae about

one hour after spraying. Some sixteen hours later no live larvae could be found.

The Archips larvae - which are nocturnal - did not contact the DDT until they emerged from their protective webbing to feed. Only a few larvae which apparently had not contacted the DDT were found alive the next morning. The plots were re-examined on July 10 and 24, 1946. No live larvae of either species could be found.

The spraying program was interrupted by a rainy period. Tests were not resumed until July 10, 1946. At that time the larvae of both insects were half grown. Four additional plots were sprayed with the following concentrations of DDT: .06% applied to 93 trees; .03% to 45 trees; .015% to 61 trees, and .007% to 70 trees. When examined some 16 hours later no Archips larvae were found alive. All sawfly larvae on plots of .06% and .03% were dead and only a few live larvae, though apparently affected by DDT, were found wandering on plots of .0125% and .007%. The plots were re-examined on July 24. No live larvae of either species could be found.

All concentrations of DDT used gave 100% control of both insect species. There is a possibility that the minimum effective concentration was not reached.

When the plots were examined on July 24, 1946 it was discovered that a deadly wilt disease had appeared among the half to nearly full grown larva causing 85 to 90% mortality to the sawfly population saving large areas of ponderosa pine reproduction from being stripped.

Archips larvae apparently were unaffected by the disease.